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Recent Advancements in Healthcare Digitalization: A Literature Review

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Abstract

This paper investigates the recent advancements in healthcare, taking into account the new possibilities of the new technologies, personalized medicine and the impact that they have on global health. It explores the way through which advanced technologies, such as blockchain technology, the Artificial Intelligence (AI), and the Augmented Reality/Virtual Reality (AR/VR) systems, offer transformation in healthcare delivery. It also explores the main elements of digitalizing healthcare, such as Electronic Helath Records (EHRs), Telemedicine, m Health, AI and Machine Learning (ML) technological systems and Internet of Medical Things (IoMT). These technologies are able to enhance data security, diagnostic accuracy and medical training, while improving the efficiency of administrative tasks. Moreover, the paper presents the benefits of personalized medicine, by emphasizing the significance of genomics and individualized treatment plans that offer targeted therapies, genetic screening and precision medicine.

JEL Classifications: C31, C50, I10, I19.

Keywords: Digitalization, Healthcare, Electronic Health Records (EHRs), Mobile Health (mHealth), Artificial Intelligence (AI) and Machine Learning (ML)

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1. Introduction

Imagine a world, in which diagnosing diseases that are characterized by high levels of complexity takes just a few seconds, where patients in remote areas can receive expert care with just the need of touching a button, and where treatment plans that are personalized, are designed by the use of a large amount of data in real-time. The existence of this ideal world is not too distant in the future. Instead, it can be considered as a part of the present, due to the rapid digitalization of healthcare, a phenomenon that is mentioned by many recent studies, such as the ones of Bhambere et al. (2021) and Gupta & Soeny (2021).According to Grand View Research (2023), "*the global digital health market size was estimated at USD 240.9 billion in 2023 and is expected to reach USD 288.6 billion in 2024*", while Fortune Business insights (2023) mentioned that "*the global digital health market size was valued USD 375.99 billion in 2022 and is projected to grow at a CAGR of 23.3% during forecast 2023-2030*"It can be considered as a testament to the way through which technology is revolutionizing the way healthcare is understood, managed and delivered. While the modern world belongs to the brink of this digital transformation, exploring the way through which the above-mentioned advancements are reshaping the landscape of the healthcare sector, through opportunities creation and challenges addressment, is crucial.

In recent years, the healthcare industry has experienced substantial transformations. These advancements in technology directly led to these changes (Gjellebæk et al., 2020). In the past, conventional healthcare involved physical documents and in-person appointments. More precisely, before digitalization, managing patient records was a difficult task (Mathai et al., 2017). It more specifically presented inefficiencies, errors, and delays in the context of the patients' care sector, as it was indicated by Blijleven et al. (2017). Following the beginning of the use of the of electronic health records (EHRs), an incident that happened during the late 20th century, as it was pointed out indicated by Johnson et al. (2021), the establishment of the groundwork was done. This offered the existence of a more interconnected and streamlined system inside the healthcare sector.

Since the internet and mobile technology ubiquity, digital solutions in healthcare had potential that have dramatically expanded. Telemedicine emerged as a powerful tool, allowing healthcare providers to remotely consult with patients, after breaking down geographical barriers. Wearable devices and mobile health applications started empowering patients to take control of their health, through the provision of real-time health monitoring and personalization of health insights (Sapci & Sapci, 2019; Seetharam et al., 2019).

More recently, discovering artificial intelligence (AI) and machine learning (ML) have opened new frontiers in diagnostics, treatment planning, and predictive analytics in healthcare. Advanced algorithms are now able to analyze vast datasets in pattern detection that are possibly missed by human eyes (Nadella et al., 2023). This progress leads to earlier diagnoses and more precise treatments. The Internet of Medical Things (IoMT) is one more innovative leap, through which smart devices are connected, in order to provide seamless, continuous monitoring of patient health (Dwivedi et al., 2022).

However, transitioning to a fully digital healthcare system is a process that is also accompanied by challenges. Some indicative issues are data privacy, interoperability of systems and the digital divide between different populations (Lythreatis et al., 2022; Reegu et al., 2021). These are challenges that need to be addressed, to harness the full potential of digital health technologies. However, the continuous advancements in digital technology show great potential to transform the way healthcare is provided, resulting in more individualized and easily accessible services with improved efficiency.

The aim of this paper is to provide an up-to-date literature review on digitalization in healthcare, focusing on recognizing the main aspects of digitalization, their advantages and obstacles, evaluating the general benefits of digitalization in healthcare and pinpointing the upcoming trends and advancements.With this review we seek to answer to the following research questions:

1. Which are the key components of digitalization in healthcare?
2. Which are the benefits of healthcare digitalization?
3. Which are the future trends and innovations of healthcare digitalization?

2. Methodology

This study employs a narrative literature review approach (NLR). This approach is chosen because it allows the synthesis of diverse perspectives from various sources. It also offers a holistic view of the current topic. According to Chukwere (2023), “NLR uses a qualitative method of synthesizing already available research on a specific subject by forming a comprehensive narrative…. It stands out for its flexibility and ability to convey a comprehensive knowledge of a subject”.

The process of our literature review involved the following phases:

- Identification of the research question:

As mentioned above, our research questions refer to the key components and the benefits of the digitalization in healthcare, as well as the future trends and innovations.

- Literature search:

Relevant literature was gathered from peer-reviewed journal articles and conference proceedings. Also, the relevant literature was collected from online publications. This review was conducted using databases such as PubMed, IEEE Xplore, ScienceDirect, and Google Scholar. So, a wide range of sources was ensured. The keywords that were used in the search included combinations of the terms “healthcare digitalization”, “electronic health records (EHRs)”, “telemedicine”, “mobile health (mHealth)”, “artificial intelligence in healthcare” and “Internet of Medical Things (IoMT)”.

– Selection if studies:

The inclusion criteria for the selecting sources were the following ones:

- Publications between 2017-2024, in order to ensure the inclusion of the most recent advancements and trends.
- Articles that were written in English.
- Studies that specifically addressed the key aspects of digital healthcare, including EHRs, telemedicine, mHealth, AI and IoMT.
- Peer-reviewed and authoritative sources.

The exclusion criteria were the following:

- Publications, which were not directly related to the healthcare digitalization.
- Opinion pieces or editorials, which lack empirical evidence.

-Analysis:

The selected literature was reviewed and categorized, based on the recurring themes; the key components of healthcare digitalization, their benefits, and the future trends. The key findings from each source were summarized and analyzed, in order to identify patterns and gaps in the current knowledge. Thematic analysis was conducted for the presentation of the findings of the current literature review. The findings were then synthesized to create a structured narrative that addressed the research questions, as they are outlined in the introductory section of the current paper.

The following table (Table 1) presents the main components of the studies that had been used in the context of the current narrative literature review:

Table 1: Studies' presentation

Author(s) (Year)	Key Component	Focus Area	Study Type	Key Findings/Notes
Melton et al. (2021)	EHRs	Electronic health records overview	Review	Highlights the components of EHRs, including medical histories and treatment plans.
Ratwani (2017)	EHRs	Impact on clinical decision-making and error reduction	Review	Discusses the improved care coordination and error reduction with EHRs.
Upadhyay & Hu (2022)	EHRs	Efficiency gains and administrative burden reduction	Qualitative analysis	EHRs reduce time on manual tasks, allowing more focus on patient care.
Feder (2018)	EHRs	Error reduction and standardization	Review	Highlights the reduction of manual errors through EHR functionalities.
Keshta & Odeh (2021)	EHRs	Privacy and security challenges	Review	Stresses the importance of cybersecurity and HIPAA compliance.
Alzghaibi & Hutchings (2022)	EHRs	Cost-related challenges of EHR adoption	Review	Discusses financial burdens of EHR implementation in small practices.
Bincoletto (2020)	EHRs	Interoperability issues	Case study	Identifies challenges in achieving seamless data exchange.
Haleem et al. (2021)	Telemedicine	Telemedicine as a subset of telehealth	Review	Describes remote healthcare delivery using telecommunication tools.
George & Cross (2020)	Telemedicine	Remotemonitoring and consultations	Review	Highlights telemedicine benefits for chronic care and rural areas.
Barbosa et al. (2021)	Telemedicine	Bridging the gap in underserved regions	Review	Reduces distances and ensures healthcare access during crises.
Omaghomi et al. (2024)	Telemedicine	Convenience for chronic conditions and regular monitoring	Systematic review	Patients benefit from follow-ups without leaving their homes.
Eze & Mateus (2020)	Telemedicine	Cost reduction and resource allocation	Umbrella review	Telemedicine minimizes transportation costs and healthcare facility strain.
Al-Samarraie et al. (2020)	Telemedicine	Infrastructure and accessibility challenges	Review	Highlights barriers due to poor internet and device access.
Nittari et al. (2020)	Telemedicine	Regulatory and licensing challenges	Review	Discusses regional licensing complexities and interstate consultations.
Iqbal et al.	Telemedicine	Data security and privacy	Review	Emphasizes the need for compliance

(2022)		concerns		with privacy laws and cybersecurity.
Iyengar (2020)	Mobile Health (mHealth)	Overview of mHealth applications	Review	Discusses mHealth tools for disease management and health promotion.
Chan (2021)	Mobile Health (mHealth)	Enhancing communication and education	Review	Explores tools for patient-provider interaction and health education.
Almutairi et al. (2023)	Mobile Health (mHealth)	Patient engagement and adherence	Systematic review	Highlights mHealth's role in improving compliance with treatment plans.
McCool et al. (2022)	Mobile Health (mHealth)	Accessibility for underserved populations	Review	Demonstrates how mHealth bridges gaps in remote areas.
Rinaldi et al. (2020)	Mobile Health (mHealth)	Cost reduction through preventive care	Systematic review	Identifies cost savings from reduced in-person visits.
Nurgalieva et al. (2020)	Mobile Health (mHealth)	Privacyconcerns	Scoping review	Highlights data security challenges in mHealth.
Deniz-Garcia et al. (2023)	Mobile Health (mHealth)	Quality issues in health apps	Review	Points out risks of misinformation due to non-standardized apps.
Hernandez-Ramos et al. (2021)	Mobile Health (mHealth)	Digital literacy and accessibility challenges	Development study	Identifies barriers for older adults and low-income populations.
Hassani et al. (2020)	AI and ML	Overview of AI in healthcare	Review	Defines AI and ML's potential in diagnostics and decision-making.
Aldung et al. (2021)	AI and ML	Pattern recognition in large datasets	Review	Highlights AI's role in early disease detection and personalized care.
Venigandla (2022)	AI and ML	Predictive analytics in radiology and pathology	Review	Explores AI's ability to identify high-risk patients and diseases.
Alowais et al. (2023)	AI and ML	AI's role in proactive healthcare	Review	Discusses personalized treatment plans based on AI-driven insights.
Blasiak et al. (2020)	AI and ML	Precision medicine and targeted treatments	Review	AI aids in creating targeted oncology treatments.
Nadella et al. (2023)	AI and ML	Data quality and bias issues	Systematic review	Examines challenges in ensuring data reliability and fairness.
Char et al. (2020)	AI and ML	Ethical considerations of AI in healthcare	Review	Discusses data ownership, patient consent, and AI bias concerns.
Khanna et al. (2020)	AI and ML	Resistance and integration challenges	Review	Explores skepticism and infrastructure limitations in AI adoption.
Ashfaq et al. (2022)	IoMT	IoMT network overview	Review	Discusses IoMT devices and their role in patient monitoring.
Parvathy et al. (2021)	IoMT	Remote monitoring capabilities	Review	Highlights real-time data collection for early health issue detection.

Rehman et al. (2021)	IoMT	Data analytics and decision-making	Review	IoMT contributes to personalized care and treatment efficacy.
Kim et al. (2022)	IoMT	Operational efficiency improvements	Review	Automates tasks and enhances resource management in healthcare.
Hireche et al. (2022)	IoMT	Security and privacy challenges	Synthesis study	Focuses on encryption and compliance with data protection laws.
Yasmeen et al. (2022)	IoMT	Interoperability challenges	Review	Identifies barriers to seamless communication among devices.
Zikria et al. (2020)	IoMT	Maintenance and infrastructure needs	Review	Discusses challenges of maintaining and updating IoMT devices.
Baumgart (2020)	Improved Patient Outcomes	Immediate access to detailed patient records	Perspective	Digital tools enable informed clinical decision-making.
Sutton et al. (2020)	Improved Patient Outcomes	AI-driven insights in treatment recommendations	Review	AI predicts risks and recommends treatments for better outcomes.
Awad et al. (2021)	Improved Patient Outcomes	Personalized treatment plans	Review	Digitalization supports tailoring treatments using genomic and lifestyle data.
Hartl et al. (2021)	Improved Patient Outcomes	Customization of treatments and decisions	Industry perspective	Emphasizes patient-specific decision-making for better results.
Senbekov et al. (2020)	Improved Patient Outcomes	Continuous remote monitoring	Review	Remote monitoring devices facilitate timely responses and health assessments.
Makiet al. (2022)	Increased Efficiency	Automation of administrative tasks	Case study	Streamlines tasks like appointment bookings and reminders.
Bajowala et al. (2020)	Increased Efficiency	Accuracy in billing and coding	Review	Automation reduces errors and speeds up reimbursement.
Kraus et al. (2021)	Increased Efficiency	Workflow management	Systematic review	Highlights integration of processes for operational efficiency.
Beaulieu & Bentahar (2021)	Increased Efficiency	Integration of healthcare delivery processes	Roadmap	EHRs integrate various aspects for efficient operations.
Goel et al. (2024)	Increased Efficiency	Emphasis on patient care	Review	Automation allows professionals to focus more on patient care.
Karatas et al. (2022)	Better Data Management	Trends and outbreak predictions	Review	Big data analytics enable population-level health management.

Agrawal & Prabakaran (2020)	Better Data Management	Evidence-based recommendations	Review	Data analytics improve diagnostics and treatment efficacy.
Ayaz et al. (2021)	Better Data Management	Interoperability and collaborativecare	Systematic review	Ensures seamless information sharing for enhanced collaboration.
Okolo et al. (2024)	Better Data Management	Reduction in unnecessarytests	Review	Efficient data sharing reduces costs and patient inconvenience.
Atluri & Thummisetti (2022)	Patient Engagement	Access to services via digital platforms	Review	Highlights apps that improve patient access and health management.
Patil et al. (2021)	Patient Engagement	Health literacyenhancement	Review	Digital platforms increase awareness and encourage active management.
MoroVisconti & Morea (2020)	Cost Reduction	Reducedoperationalcosts	Review	Digital solutions minimize manual tasks and physical storage needs.
Secundo et al. (2021)	Cost Reduction	Optimizedresourceallocation	Review	Improved planning and allocation through digital tools.
ElKhatib et al. (2022)	Cost Reduction	Savings from reduced paper usage and manual processes	Review	Highlights significant cost reductions from digitalization.
Baum et al. (2021)	Cost Reduction	Remote consultations reduce travel expenses	Review	Telehealth minimizes costs for patients and providers.
Niaz & Nwagwu (2023)	Cost Reduction	Healthcare Demand forecasting	Review	Digital tools predict demands for better planning and efficiency.
Wang et al. (2019)	Blockchain	Secure information exchange	Case study	Blockchain ensures secure, private, and reliable data sharing.
Musamih et al. (2021)	Blockchain	Supply chain integrity	Review	Guarantees authenticity of medications and medical equipment.
Maslove et al. (2018)	Blockchain	Clinical trial reliability	Proof-of-concept	Blockchain enhances trust and transparency in clinical trials.
Venigandla (2022)	Advanced AI	AI in medical imaging and personalized treatment	Review	Identifies diseases early and creates tailored treatment strategies.
Rana & Shuford (2024)	Advanced AI	Predictive analytics	Review	AI forecasts patient outcomes and improves intervention strategies.
Willis et al. (2020)	Advanced AI	Simplification of administrative tasks	Mixed methods	AI alleviates workload, enhancing operational efficiency.
Hsieh & Lee (2018)	AR/VR	Medicaltraining and education	Preliminary study	AR/VR replicates medical situations for training purposes.

Desselle et al. (2020)	AR/VR	Assistance in surgeries	Review	AR overlays critical information for surgical precision.
Logan et al. (2021)	AR/VR	Pain management and mental health therapy	Position paper	VR offers innovative treatment options for mental health.
Bombart et al. (2022)	Personalized Medicine	Genetic screening and preventive care	Review	Genomics allows for risk identification and prevention strategies.
Pellat et al. (2023)	Personalized Medicine	Targeted therapies	Collaborative study	Tailors treatments to genetic makeup for better efficacy.
Silva et al. (2021)	Personalized Medicine	Pharmacogenomics for tailored drug prescriptions	Review	Guides personalized drug prescriptions based on genetics.
Busnatu et al. (2022)	Personalized Medicine	Customized healthcare approaches	Review	Combines genetics, lifestyle, and environmental factors for precise care.
Zhu et al. (2022)	Personalized Medicine	Real-time health monitoring	Review	Wearables enable proactive management of chronic illnesses.
Dang et al. (2021)	Personalized Medicine	Patient-centered decision-making	Review	Ensures inclusion of patient preferences for comprehensive care.

3. Key Components of Digitalization in Healthcare

3.1 Electronic Health Records (EHRs)

The EHRs are electronic copies of the physical charts of the patients. It concerns a key element of healthcare information technology systems. To be more precise, electronic health records offer timely, individualized patient information. These are detailed records, the main priority of which is the patient. They also provide immediate and secure access to authorized individuals in the records of the patients. When we are mentioning electronic records, we mean a variety of files that store patient information. Characteristic examples of these files are the medical histories, the diagnoses of the patients, their medications and their treatment plans, the corresponding immunization dates, the patients' allergies, the radiology images and any laboratory test results (Melton et al., 2021).

It is worth mentioning that electronic health records allow access to healthcare, thorough and updated histories of the medical state of a patient. This leads to more accurate diagnoses and effective treatments. They, also, facilitate better coordination among healthcare providers. This facilitation is successful by ensuring that all medical professionals, who are involved in patients' care, are able to access the same data and information (Ratwani, 2017).

As mentioned by Upadhyay & Hu (2022), through the replacement of paper records, EHRs are helpful in reducing the administrative burden on healthcare professionals and the rest of healthcare staff. Specifically, information is readily accessible, while the time spent on retrieving, filing and managing physical records is reduced. It is a type of efficiency that translates to more time for patient care and is able to improve the overall operational workflow within healthcare facilities.

Upadhyay & Hu (2022) and Feder (2018) mention another benefit of EHRs, according to which they reduce the risk of errors that are associated with manual data entry and handwritten records. At this point, EHRs offer functionalities. Characteristic examples of these kinds of functionalities are templates, automated coding and prompts. These functionalities help in maintaining standardized and accurate documentation.

On the other hand, the digital storage of patient information raises significant privacy and security concerns, and this is the first significant and worth-mentioning challenge of EHRs. Unauthorized access, data breaches, and hacking attempts might compromise sensitive health information. In order for this challenge to be successfully faced, ensuring robust cybersecurity measures and compliance with regulations like the Health Insurance Portability and Accountability Act (HIPAA) are considered vital (Keshta & Odeh, 2021).

In addition, the transition from paper-based to electronic records involves substantial financial investment. Costsindicatively include purchasing and maintaining hardware and software, human resources training and integrating EHR systems with the already existing infrastructure. Smaller healthcare practices might find these expenses particularly importunate (Alzghaibi & Hutchings, 2022).

Ultimately, EHR systems from various suppliers frequently struggle to effectively communicate with one another. This creates another difficulty, causing patient data to become fragmented across various platforms. The achievement of seamless data exchange and the interoperability are twosignificant obstacles in the full utilization of the EHRs, as it was supported by the study of Bincoletto (2020).

3.2 Telemedicine

Firstly, it has to be clarified that telemedicine belongs to the telehealth sector. Telemedicineis the use of digital information and telecommunication technologies. Telemedicine uses technological systems that have as main purpose the delivery of remote clinical healthcare services (Haleem et al., 2021). For example, telemedicine comprises of video calls, monitoring from a distance, and health apps for mobile devices.

Telemedicine includes a variety of different components. These different components allow healthcare professionals to diagnose, treat and monitor their patients. These actions are allowed, without the professionals' need for physical appointments with their clients (George & Cross, 2020). This clarifies the reason why telemedicine might be accompanied by important advantages in the rural areas, or in the case of regions that are underserved and that have restricted access to healthcare. Telemedicine reduces the existing distance between people and healthcare services' providers. This occurs in order to guarantee that individuals living in distant, rural, or underserved areas can receive necessary medical care. This advantage is crucial, particularly in times of crisis or for patients who have restricted mobility (Barbosa et al., 2021).

Even more, patients might receive medical consultations and follow-ups without needing to leave their homes. It is about a convenience that is significant for those with chronic conditions or requires regular monitoring (Omaghomi et al., 2024).

Furthermore, Eze & Mateus (2020) mentioned that through the minimization of the need for in-person visits, telemedicine might significantly cut down on transportation and associated healthcare costs. Moreover, it can decrease the strain on healthcare facilities because it allows them to efficiently allocate the existing resources.

Al-Samarraie et al. (2020) pointed out that, despite the above benefits that telemedicine offers, its successful implementation depends on reliable internet connectivity and the availability of digital devices. This means that patients who live in areas with poor internet infrastructure or patients who have not direct access to smartphones or computers, are likely to be excluded from telemedicine services.

Nittari et al. (2020) supported that telemedicine practices must navigate a complex landscape of regulations and licensing requirements that vary by region. Providers often need to be licensed in the patients' locations, complicating interstate or international consultations. This is another significant challenge of the implementation of telemedicine services in healthcare.

Like EHRs, telemedicine platforms handle sensitive patient information, that must be protected from breaches and unauthorized access. Ensuring compliance with privacy laws and employing robust cybersecurity measures are essential measures for the maintenance of patient trust and confidentiality (Iqbal et al., 2022).

3.3 Mobile Health (mHealth)

The term "mHealth" is commonly used to describe Mobile Health, which involves utilizing mobile devices and wireless technology, in order to aid in meeting health goals. It encompasses various types of applications, from mobile health apps to texting programs, which are specifically created to provide effective assistance with managing diseases, adapting to lifestyle changes and promoting public health efforts (Iyengar, 2020). Similarly to Telemedicine, mHealth helps connect patients and healthcare providers by providing customized tools for communication, education and monitoring to meet individual health needs (Chan, 2021).

As noted by Almutairi et al. (2023), mobile health (mHealth) applications enable individuals to play a more active part in overseeing their health through the provision of personalized health data, medication alerts and monitoring tools for health improvement. This fosters patients' involvement and may result in improved compliance with their treatment regimens.

In addition, mobile health technologies provide easy access to healthcare services and information, regardless of the time and place. It is a useful characteristic that is even more beneficial for individuals in remote or underserved areas. This beneficial characteristic offers the benefit of assurance that even more people are able to receive timely medical advice, monitor chronic conditions and access preventive care (McCool et al., 2022).

As Rinaldi et al. (2020) indicated, through their literature review, mHealth is able to reduce healthcare costs by minimizing the need for in-person visits, streamlining care coordination and offering preventive care that reduces the occurrence of complications that can possibly appear in the cases of any chronic diseases. Mobile technology is also able to facilitate efficient health data collection and reporting.

On the contrary, despite the above benefits, the protection of sensitive health information on mobile devices is a major concern and that is why it is considered a significant challenge (Nurgalieva et al., 2020).

The vast array of health apps that are available can vary significantly in quality. This is another challenge that relies on the fact that not all apps are developed with input from healthcare professionals. At the same time, not all apps are based on scientific evidence. These uncertainties are posing risks of misinformation (Deniz-Garcia et al., 2023).

The success of mHealth solutions is also reliant on users' competency in using mobile technology. The meaning of this fact is that the aged adults or people with low income are

possible to have difficulties, and the reason is the fact that they have not enough digital literacy, neither efficient access to smartphones or internet (Hernandez-Ramos et al., 2021).

3.4 Artificial Intelligence (AI) and Machine Learning (ML)

Artificial Intelligence (AI) is the replication of the intelligence of real people, in machines.The main purpose of the artificial intelligence systems is the mimic of human thinking and people's behavior (Hassani et al., 2020). AI is recognized as a wider field that includes Machine Learning (ML) within it. In a more detailed manner, machine learning consists of teaching algorithms with a vast quantity of data, so they can identify patterns and make decisions (Aldung et al., 2021). Within the healthcare field, AI and ML are utilized for examining intricate medical data to aid in diagnosing, predicting outcomes and customizing treatment plans.

Venigandla (2022) mentioned that AI and ML algorithms are able to process large datasets, in order to identify patterns and anomalies that human practitioners might overlook. This offered capability is useful in fields like radiology and pathology, where these types of technologies are able to detect early signs of diseases, such as cancer, with high accuracy.

AI can also forecast patient results using past data. Specifically, healthcare providers have the benefit of a better high-risk patient's identification. This is considered as beneficial, because they have the ability to intervene sooner. Additionally, predictive models are able to efficiently predict disease outbreaks, hospital readmissions and deteriorations of the patients. AI and ML systems offer advantages that promote a more proactive and preventive approach to healthcare, as stated by Alowais et al. in 2023. Using AI and ML, personalized treatment plans could be created for patients by taking into account their specific genotype, lifestyle and medical history. AI is utilized in precision medicine strategies, like in oncology, to develop very targeted treatments that have the potential to enhance patient results (Blasiak et al., 2020). Extensive quantities of top-notch data are required for AI and ML models to work effectively. Unreliable or prejudice data may result in incorrect forecasts and evaluations. Having this in mind, maintaining the accuracy and variety of data poses a notable difficulty (Nadella et al., 2023).

AI utilization in the healthcare sector provokes ethical inquiries. For instance, these inquiries revolve around patient approval, who owns the data, and the possibility of bias in AI decision-making. Rules and effective moral principles should develop in order to tackle these notable difficulties (Char et al., 2020), which are also present in the aforementioned essential elements like EHRs, mHealth and Telemedicine.

One more significant challenge that concerns AI and ML use in healthcare is the difficulty and complexity of AI systems integration into existing healthcare workflows. This difficulty requires significant changes to infrastructure and procedures. Additionally, resistance from healthcare professionals can exist, because of concerns that they might have on job displacement or skepticism of AI's reliability (Khanna et al., 2020).

3.5 Internet of Medical Things (IoMT)

The IoMT is a network of medical devices and applications that gather, evaluate and send health information online. The network of the IoMT consists of wearable gadgets. It furthermore includes remote monitoring systems and intelligent medical tools. It also allows real- time monitoring and exchanging of data. It undoubtedly leads to higher levels of quality in patient care, it helps the improvement of the clinical results and it ends up to the existence of a more efficient operation of the system of the healthcare provision (Ashfaq et al., 2022).

From IoMT devices, continuous monitoring of patients' vital signs and health metrics are provided. These enable early detection of health issues since real-time data transmission allows healthcare professionals to monitor patients remotely. This ensures timely interventions and reduces hospital readmissions, as well (Parvathy et al., 2021).

The vast amounts of data that are collected by IoMT devices are able to be analyzed in order to uncover insights into patient health trends, disease progression and treatment efficacy. At this point, advanced analytics and AI can predict health outcomes and keep clinical decisions fully informed. Finally, this leads to more personalized care plans that are more effective for each patient, depending on his/her personal and specific characteristics (Rehman et al., 2021).

IoMT solutions provide a substantial enhancement to the efficiency of healthcare operations. Automating everyday tasks, predicting and minimizing errors and improving resource allocation can lead to success. Effective management of inventory guarantees that medical supplies and equipment are consistently well-stocked, reducing delays and keeping clinical workflows running smoothly (Kim et al., 2022).

On the other hand, sharing sensitive health information online poses noteworthy security and privacy issues. It is a difficulty that has been brought up previously as well. At this stage, it is essential to make sure IoMT devices follow data protection regulations like HIPAA, and to put strong encryption and cybersecurity measures in place, in order to protect patient information (Hireche et al., 2022).

Additionally, the varied assortment of devices and systems in the IoMT network could present issues with interoperability. Ensuring smooth communication and data sharing across various devices and platforms is crucial for optimizing the benefits of IoMT solutions (Yasmeen et al., 2022).

Additionally, integrating and maintaining IoMT devices and systems can be challenging and require significant resources. For this reason, healthcare providers need to allocate resources for infrastructure, training and assistance. By undertaking these crucial tasks, they can guarantee the effective functioning of IoMT solutions. Moreover, continuous updates and adaptations are necessary, due to the fast technological progress in the field (Zikria et al., 2020).

4. Benefits of Healthcare Digitalization

The healthcare industry is being transformed digitally. This digital transformation changed the way through which medical services are provided by offering a lot of benefits that enhance efficiency and effectiveness. With the growing utilization of digital technologies in healthcare systems, the provision of care has changed, being more personalized, even more efficient, and driven by data. This change improves patient results and operational efficiency, encourages data management, offers more control to the patients, and decreases the pre-existing costs. In the upcoming sections, the diverse advantages of digitalizing healthcare are analyzed, emphasizing its effects on patient care, healthcare professionals, and the broader healthcare system.

4.1 Improved Patient Outcomes

The digitalization of healthcare provides a valuable advantage by improving clinical decision-making. Initially, digital tools give healthcare providers immediate access to thorough patient records. This enables them to make more knowledgeable clinical decisions (Baumgart, 2020).

Even more, as Sutton et al. (2020) suggested, AI-driven insights are able to recommend treatments, predict patient deterioration, and identify potential health risks.

The ability to create personalized treatment plans is one more reason why health digitalization might be beneficial. Personal health data, including genomic data and lifestyle information, can be used to tailor treatment plans, making them more effective (Awad et al., 2021).

Healthcare customization, with decisions and treatments that are tailored to individual patients in every possible way, have a direct positive result to better health outcomes (Hartl et al., 2021).

Continuous remote monitoring is also beneficial and has a lot of abilities. More specifically, many devices offer continuous remote monitoring, such as for example glucose monitors, EKG sensors, and sleep trackers. Through remote monitoring, solutions are allowed for the ongoing assessment of patient health. Moreover, facilitation of timely medical responses is also achieved (Senbekov et al., 2020).

4.2 Increased Efficiency and Productivity

Except from improved patient outcomes, another benefit of digitalization in healthcare is increased efficiency and productivity. This increase is coming as a direct positive outcome of the existence of streamlined administrative processes.

Specifically, systems are able to automate appointment booking, reminders and follow-ups. These automatically driven actions reduce the administrative burden on medical staff (Maki et al., 2022).

Moreover, digital solutions in healthcare improve accuracy in billing and coding. This is considered a benefit due to the fact that it helps the reduction of errors and accelerates reimbursement processes (Bajowala et al., 2020).

As Kraus et al. (2021) mentioned, enhanced workflow management is another benefit of healthcare digitalization. For example, EHRs and other digital tools that can be used in healthcare and that were described in the previous section, integrate various aspects of the healthcare delivery process, ensuring more efficient and successful operations (Beaulieu, M., & Bentahar, 2021).

Except from the above positive outcomes, the integration of automated systems in the healthcare services provision offers a more efficient handling of the existing routine tasks. This allows healthcare professionals to place more emphasis on their patients' care (Goel et al., 2024).

4.3 Better Data Management and Analytics

The benefit that is about better data management and analytics, and which come through the healthcare sector digitalization concern the existence and development of data-driven insights. These insights can be given for example through big data analytics. More specifically, by analyzing large datasets, healthcare professionals gain the ability to the

trends identification, outbreaks prediction and the overall population's effective health management (Karatas et al., 2022).

Moreover, data analytics are able to offer recommendations, based on existing evidence, to the healthcare providers. This improves diagnostic accuracy and efficacy of the treatment that is suggested by the professionals and followed by their patients (Agrawal & Prabakaran, 2020). Furthermore, digital records ensure that patient information is easily and directly shared across different healthcare providers and institutions. This happens due to the ability of interoperability, which empowers collaborative care provision (Ayaz et al., 2021; Cerchione et al., 2023). Finally, efficient data sharing leads to the minimization of unnecessary tests and procedures. It is considered a further benefit coming from healthcare digitalization, because of the reduction of healthcare costs and possible patient inconvenience (Okolo et al., 2024).

4.4 Patient Engagement and Empowerment

The digitalization of healthcare is leading to the fact that patients have the tendency to become more involved and even more empowered. This digitalization enhances the access of the patients to the needed services, in order for them to receive the appropriate care for their health. Furthermore, individuals are able to utilize these channels to access their health records, make appointments via the internet, request medication renewals and have direct communication with their healthcare professionals. At the same time, current Mobile Health Apps allow patients to monitor their health measurements, get reminders for their medications and reach educational material (Atluri & Thummisetti, 2022).

In addition, the digitalization of healthcare increases patients' health literacy. Specifically, digital platforms provide patients with access to tailored health education materials. This opportunity helps the patients to understand their health conditions and the treatment options that they have at their disposal. Moreover, interactivetools, such as symptom checkers and health risk assessments, empower patients to take an active role in their health management (Patil et al., 2021).

4.5 Cost Reduction and Financial Benefits

Cost reduction and financial benefits for both patients and healthcare providers are further worthwhile benefits of healthcare digitalization. These benefits come from reduced operational costs (Moro Visconti & Morea, 2020) and optimized resource allocation (Secundo et al., 2021).

In more detail, digitalization in the sector of healthcare reduces the need for paper records, manual processes and physical storage. These reductions mean significant cost savings (El Khatib et al., 2022). Additionally, by enabling remote consultations, telehealth leads to the reduction of the need for physical visits of patients. This has a direct positive outcome that concerns savings on travel and facility costs (Baum et al., 2021).

Furthermore, digital tools that are used in the healthcare sector are able to forecast healthcare demands. Through these forecasts, better resource planning and allocation are succeeded (Niaz, M., & Nwagwu, 2023). Digital solutions, after all, as it was stated by Beaulieu & Bentahar (2021), streamline the management of medical supplies and equipment. This ensures adequate stock levels and waste reduction, as well.

5. Future Trends and Innovations

With the ongoing changes in healthcare sector, the future is going to be influenced by innovations and technologies that are expected to lead both patient care and medical practices to a notable transformation. These advancements are going to improve the accuracy, productivity, and customization of healthcare, overcoming the present obstacles and creating new opportunities for treatment and patient involvement. At the upcoming sections, the future trends and advancements, which will have a significant influence on the healthcare sector, are explored.

5.1 Emerging Technologies

1. Blockchain: Blockchain's distributed ledger technology guarantees that the exchange of patient information among various healthcare providers is carried out with the necessary levels of security. At the same time, Blockchain technology ensures both privacy and data integrity (Wang et al., 2019). Additionally, Blockchain is able to provide a lasting documentation of the medical supply chain. This ensures the authenticity of the medications and the existing medical equipment. This skill aids in reducing the likelihood of fake products (Musamih et al., 2021). Improved handling of clinical trials is achievable by utilizing Blockchain technology. In a more detailed manner, Blockchain technology has the potential to enhance the trustworthiness and openness of clinical trials through the creation of an unchangeable record of information and outcomes. Enhanced trust and reproducibility are outcomes directly linked to this (Maslove et al., 2018).

*2. Advanced AI (Artificial Intelligence): "*Sophisticated" AI algorithms have the capability to proceed to the examination of the medical images, as well as of the laboratory findings and the saved patients' records. This can be done with great accuracy. It also proves that these kinds of AI algorithms may assist in identifying diseases sooner than the expected and develop personalized treatment strategies for the patients (Venigandla, 2022). Moreover, sophisticated AI tools can continue with the examination of extensive datasets and ultimately forecast patient results. Advanced AI systems can use this analysis to detect vulnerable populations and enhance treatment strategies (Rana & Shuford, 2024). Ultimately, AI has the capability to simplify administrative tasks. Some indicative examples of these tasks are the activities of scheduling, billing and coding. As mentioned by Willis et al. (2020), this alleviates the workload for the professionals that are working in healthcare. It furthermore increases the levels of the efficiency of this specific industry. So, healthcare providers can be fully concentrated on the quality of their offered services (Willis et al., 2020).

3. Augmented and Virtual Reality (AR/VR): Augmented reality and virtual reality technologies replicate authentic medical situations. Hsieh & Lee (2018)mentioned that these types of technologies have this specific ability, which means that these systems are able to provide training experiences for both the cases of the medical students and the professionals.AR can assist surgeons by overlaying critical information and 3D images onto the surgical field. It is an existing option that enhances precision and the outcomes of the health services that have been offered by the professionals (Desselle et al., 2020).As for VR, itis able to be utilized for pain management and for mental health therapy, as well. Consequently, VR systems, through these uses, offer innovative treatment options for various conditions of the patients' health (Logan et al., 2021; Tashjian et al., 2017).

5.2 Personalized Medicine

Advances in genomics allow for comprehensive genetic screening. Through this comprehensive genetic screening, the identification of the patients that belong to the high-risk category per disease is possible. Preventive care is possible too (Bombart et al., 2022).Furthermore, targeted therapies and treatments are able to be offered as well. Treatments might be tailored based on an individual's genetic makeup, leading to more effective and less invasive interventions (Pellat et al., 2023).Finally, understanding the way through which genetic variations affect individual responses to medications, through

pharmacogenomics, can guide personalized drug prescriptions. This minimizes the adverse effects and maximizes the efficacy of a pharmacy-based treatment plan (Silva et al., 2021).

Through precision medicine, customized healthcare approaches consider patients' genetic profiles, lifestyles and environmental factors. These ensure that treatment plans are specific and effective (Busnatu et al., 2022). Monitoring health is another component of personalized treatment plans, which utilizes wearable devices and mobile health apps to observe individual health metrics in real-time. This allows for the proactive handling of long-term illnesses and personalized interventions as well (Zhu et al., 2022). Additionally, personalized medicine prioritizes incorporating patient preferences and values in clinical decision-making. This concerns healthcare services focused on the patient, promoting a more comprehensive and personalized approach to the entire healthcare industry (Dang et al., 2021).

6. Conclusions and Future Research

The implementation of digital technology in healthcare has numerous advantages, such as improving patient results, increasing operational productivity, better managing data and boosting patient involvement. Despite facing challenges such as the necessity for strong cybersecurity measures and the incorporation of old systems, the undeniable positive influence of digital transformation on healthcare remains. Innovations and technological advancements are indicating the future of the healthcare. A variety of modern technologies that were mentioned and analyzed in this paper are offering a valuable transformation of the management of the healthcare data. This is happening by better performing diagnostics and quicker delivering medical training. From a practical perspective, this transformation implies that healthcare providers might need to adopt new digital competencies. They also need to integrate emerging technologies into their routine medical practice. As for society, these advancements ensure a better healthcare access. They also ensure improved patient outcomes. Further research should focus on optimizing digital tool implementation to maximize their benefits, while minimizing their limitations.

Moreover, digital health solutions are able to greatly enhance the health sector, in a global extent. This can happen more intensively particularly during pandemics and crises, such as the recent Covid-19 pandemic crisis. This advantage is achieved through improving capabilities in data analytics, telehealth and mobile health. These are upcoming trends that signal a more productive, efficient and fair healthcare system, emphasizing the significant influence of digital transformation on world health and patient results. For global health systems, these digital health solutions provides a framework for rapid response to

pandemics and crises. This means improving resilience and adaptability. It also underscores the need for policy development. It underscores the need for regulatory frameworks, which support the widespread and ethical implementation of digital health interventions, as well. Future research should examine the long-term sustainability and equity of such solutions. The aim of this research will be to ensure that they benefit all populations, particularly in the low-resource settings.

In conclusion, there is a significant opportunity for more digitalization in the healthcare sector, which has the potential to drastically transform the industry by incorporating advanced technology and enhancing patient involvement. Progress in AI and machine learning could provide unparalleled accuracy in diagnoses and customized treatment strategies, while blockchain technology could guarantee strong data protection and openness. The growth of telehealth and remote monitoring will make healthcare more accessible to patients, even in remote areas. Additionally, the combination of interconnected digital platforms can improve compatibility, allowing for a more united and organized healthcare system that promotes ongoing, comprehensive patient care. As these advancements progress, the future path leads to a healthcare system that is more effective and fair, giving power to both patients and healthcare professionals. In practice, this shift calls for enhanced interoperability among healthcare systems. It also calls for a better digital literacy among, both, medical professionals and patients. For the overall society, the increased accessibility and the fairness of the digitalized healthcare might help to reduce the already existing health disparities. Research should explore how to optimize these technologies, especially for the underserved populations, while ensuring the ethical and secure use of the digital healthcare platforms.

As healthcare digitalization progresses, there are multiple important areas where future research could be useful. A notable area of study is the financial effect of these technologies, especially in terms of analyzing costs and benefits in healthcare systems. It is essential to examine the long-term financial consequences of implementing digital technologies such as blockchain, AI, and IoMT. The key areas of focus for this research should be the impact of these technologies on healthcare costs, resource distribution, and operational efficiency, to guarantee that investments are both economically feasible and enduring..

Another essential area to investigate in the field of Management Accounting is within the field of Administrative Accounting. Comprehending the financial aspects of digital transformation projects in healthcare, such as for example the budgeting, the controlling costs, and the reporting finances, might aid in developing better tactics for overseeing these

advancements. Furthermore, there is potential for further investigation into creating innovative financial models that effectively represent the ROI and TCO of healthcare digitalization projects.

Additionally, it might be important for research to further investigate the ethical concerns that are related to the digital healthcare, such as for example the data privacy, the security, and the risk of bias in decision-making, that is driven by AI. Further investigation is needed on how the interoperability of different digital health systems affects the continuity of patient care. It is crucial for the success of future healthcare systems to grasp the importance of upholding high standards of care while incorporating new technologies across various platforms. From an ethical perspective, ensuring fairness in AI-driven decision-making and securing patient data are paramount concerns. Practically, this arises the need for clearer regulatory policies. It also calls for best-practice guidelines, which address these challenges. Society must also engage in discussions about the ethical implications of digital healthcare, particularly regarding data ownership and patient consent.

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